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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

LEE, SIN J

ART UNIT PAPER NUMBER

1752

DATE MAILED: 11/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/992,560	Applicant(s) GONSALVES, KENNETH E.	
	Examiner Sin J. Lee	Art Unit 1752	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 October 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 6,7,11,14-59,62,65-71 and 74-82 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 11,29,49,50 and 65-71 is/are allowed.
- 6) ☒ Claim(s) 6,7,14-17,19-28,30-32,34,35,37-39,42,43,47,48,51,52,55-57,59,62 and 74-82 is/are rejected.
- 7) ☒ Claim(s) 18,25,28,33,36,40,41,44-48,53,54,58 and 81 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 05 November 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>08-22-2002</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicants canceled claims 1-5, 8-10, 12, 13, 60, 63, 64, 72, and 73 (those claims were previously rejected over Kita et al (JP'881), Aoai et al'250, and Seino et al'148 (as addressed in Paragraphs 10-13 of Final Office action mailed on June 25, 2004).
2. Upon reconsideration in view of applicants' argument, the previous rejection on claims 22-28 and 30-37 under 35 U.S.C. 112, first paragraph (as addressed in Paragraph 9 of Final Office action mailed on June 25, 2004) is hereby withdrawn.
3. **Due to newly cited prior arts, the following rejections are made non-final.**

Claim Interpretations

4. Based on the reading of present specification (pg.15-18, Examples 7 and 8, Figures 1 and 2), present *polymeric* chemically amplified resist of claims 22-28 and 30-37 is interpreted by the Examiner to be a *polymer* that comprises (i) a repeat unit that contains a methacrylate component but does not contain a polyhedral oligosilsesquioxane moiety and (ii) a repeat unit that contains a polyhedral oligosilsesquioxane component.
5. Based on the reading of present specification (pg.15-18, Examples 7 and 8, Figures 1 and 2), present *polymeric* chemically amplified resist of claim 29 is interpreted by the Examiner to be a *polymer* that comprises (i) a methyl methacrylate repeat unit, (ii) t-butyl methacrylate repeat unit, (iii) methacrylic acid repeat unit, and (iv) 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate repeat unit.

6. Based on the reading of present specification (pg.18-23, Example 13, and Fig.2), present *polymeric* chemically amplified resist of claims 38-48 and 51-59 is interpreted by the Examiner to be a *polymer* that comprises (i) a methacrylate component and (ii) a photoacid generating component (and those two components do not have to come from two different repeat units of the polymer).

The *polymeric* chemically amplified resist of present claims 40 and 53 were interpreted by the Examiner to be a *polymer* that comprises (i) a methacrylate component, (ii) a photoacid generating component and further comprises (iii) a dissolution promoting moiety within the same polymer.

The *polymeric* chemically amplified resist of present claim 44 is interpreted by the Examiner to be a *polymer* that comprises (i) a methacrylate component, (ii) a photoacid generating component, and *further comprises* (iii) a polyhedral oligosilsesquioxane component within the same polymer.

7. The *polymeric* chemically amplified resist of present claim 49 is interpreted by the Examiner to be a *polymer* that comprises (i) a methyl methacrylate repeat unit, (ii) t-butyl methacrylate repeat unit, (iii) methacrylic acid repeat unit, (iv) 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate repeat unit, and (v) [*p*-CH₂=C(CH₃)C(O)OC₆H₄SMe₂]OSO₂CF₃ repeat unit.

8. The *polymeric* lithographic resist of present claim 62 is interpreted by the Examiner to be a *polymer* which contains the [*p*-CH₂=C(CH₃)C(O)OC₆H₄SMe₂]OSO₂CF₃ repeat unit.

9. Based on the reading of present specification (pg.25-27 and Example 20), the polymeric resist of present claims 65-71 is interpreted by the Examiner to be a polyacetal polymer into which a polyhedral oligosilsesquioxane disilanol component is incorporated.

Claim Objections

10. Claim 18 is objected to because of the following informalities: In lines 1-2, applicants need to change "nanocomposite resist" to --- polymer component ---. Appropriate correction is required.

11. Claim 25 is objected to because of the following informalities: In line 2, applicants need to insert --- of --- between "weight" and "the". Also, in line 2, applicants need to change "polymer" to --- polymeric resist ---.

12. Claim 28 is objected to because of the following informalities: In line 2, applicants need to change "polymer" to --- polymeric resist ---.

13. Claim 46 is objected to because of the following informalities: in line 2, applicants need to insert --- of --- between "weight" and "the". Also, in line 2, applicants need to change "polymer" to --- polymeric resist ---.

14. Claim 47 is objected to because of the following informalities: in line 2, applicants need to change "polymer" to --- polymeric resist ---.

15. Claim 48 is objected to because of the following informalities: in line 2, applicants need to change "polymer" to --- polymeric resist ---.

16. Claim 81 is objected to because of the following informalities: In line 2, applicants need to insert --- of --- between "weight" and "the".

Claim Rejections - 35 USC § 112

17. Claim 56 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 56 recites the limitation " *the polyhedral oligosilsesquioxane component* comprises . . ." in lines 1-2. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

18. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

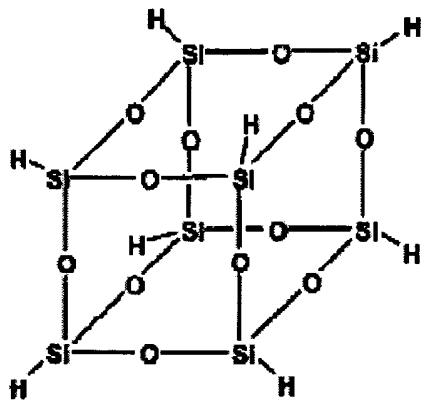
19. Claims 6 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Ito et al (5,459,021).

Ito teaches (see col.3, lines 11-16) a silver halide photographic light-sensitive material comprising a support having on one side thereof a light-sensitive silver halide emulsion layer, in which the photographic light-sensitive material further has a magnetic

recording layer and *a layer containing particles of a metal oxide having a crystallite size of 1-20 nm on the average*. Ito furthermore teaches (col.7, lines 33-40) that the average size of the metal oxide particles is *preferably 1-3.5 nm*. Based on this teaching, one of ordinary skill in the art would immediately envisage using the metal oxide particles having the average size of 1 nm because 1 nm is *clearly disclosed* as the lower end of the taught range. Ito also teaches (col.8, lines 21-35) *binders* to be used *in combination with* those metal oxide particles. Since Ito teaches present nanoparticle component of claims 6 and 7 and present polymer component, Ito's composition containing metal oxide particles having the average size of 1 nm and a binder inherently teaches present nanocomposite resist. Therefore, the prior art teaches present inventions of claims 6 and 7.

20. Claims 6 and 7 are rejected under 35 U.S.C. 102(b) as being anticipated by Kita et al (JP 2000-334881 and its English abstract provided by JPO) (with Lichtenhan et al (6,716,919 B2), which is cited here to support the Examiner's assertion that octacyclohexyl polyhedral oligomeric silsesquioxane (octacyclohexyl POSS) is known to have the particle diameter size of about 1.5 nm).

Kita teaches a mixture of a cage-shaped silsesquioxane and an organic polymer (see the English abstract), and one of the examples for the cage-shaped silsesquioxane has the following structure (see pg.8 of the Japanese document):



Octacyclohexyl polyhedral oligomeric silsesquioxane (octacyclohexyl POSS) has the same structure to the compound shown above, except that those H atoms are replaced by eight cyclohexyl groups, and octacyclohexyl POSS is known to have the particle diameter size of about 1.5 nm, as evidenced by Lichtenhan, col.5, Table 1. It is the Examiner's position that Kita's cage-shaped silsesquioxane of above structure would have even smaller particle diameter size than 1.5 nm because hydrogen atoms are clearly smaller than cyclohexyl groups of octacyclohexyl POSS. Therefore, Kita teaches present nanocomposite resist of claims 6 and 7.

21. Claim 6 is rejected under 35 U.S.C. 102(e) as being anticipated by Takamuki (6,468,725 B2).

In claim 1, Takamuki teaches a lithographic printing plate precursor comprising a support having provided thereon a light-sensitive layer containing fine anatase titanium oxide grains and a complex composed of an organometallic polymer and an organic polymer containing an amido bond, a urethane bond, a ureido bond, or a hydroxyl group. In claim 5, Takamuki furthermore teaches that an average particle size of the anatase titanium oxide grains is from 5-500 nm. Based on this teaching, one of ordinary

skill in the art would immediately envisage using anatase titanium oxide grains having the average particle size of 5 nm because 5 nm is clearly disclosed as the lower end of the taught range. Therefore, Takamuki teaches present nanocomposite resist of claim 6.

22. Claim 6 is rejected under 35 U.S.C. 102(e) as being anticipated by Kita et al (6,468,717 B2).

Kita teaches (see abstract) a heat-sensitive lithographic printing plate precursor, which comprises an aluminum support having provided thereon an ink-receptive layer and a hydrophilic layer containing a colloidal particle oxide or hydroxide of at least one of beryllium, magnesium, aluminum silicon, titanium, boron, germanium, tin, zirconium, iron vanadium, antimony and transition metals. Kita furthermore teaches (col.8, lines 25-33) that as the colloid particle size of the oxide or hydroxide of these elements, spherical particles having a particle diameter of 5-100 nm are *preferably used* in the case of silica in the present invention. Based on this teaching, one of ordinary skill in the art would immediately envisage using silica particles having a particle diameter of 5 nm in Kita's invention because 5 nm is clearly disclosed as the lower end of the taught range. Kita also teaches (col.8, lines 40-67) that hydrophilic resin can be used together with the colloidal particles in the hydrophilic layer. Therefore, Kita teaches present nanocomposite resist of claim 6.

23. Claims 14-17, 19, 20, 22, 23, 25, 26, 28, 30, 31, 34, 35, 37, 74-76, 79, 81, and 82 are rejected under 35 U.S.C. 102(b) as being anticipated by Gonsalves et al ("Combinatorial Approach for the Synthesis of Terpolymers and Their Novel Application

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as Very-high-contrast Resists for X-ray Nanolithography", *Journal of Vacuum Science Technology*, B 18(1), Jan/Feb 2000, pg.325-327).

Gonsalves teaches (pg.325) a resist system for x-ray lithography for ultralarge scale integration circuits, which comprise a terpolymer of methyl methacrylate, tert-butyl acrylate, and polyhedral oligosilsesquioxane (POSS) (with the wt.% of POSS being 14.3) which has the polydispersity index of 1.45. Gonsalves exposes his resist to x-rays and the exposed resist undergoes wet development. Therefore, the prior art teaches present inventions of claims 14, 16, 17, 19, 22, 23, 25, 28, 30, 31, 34, 37, 76, 79, and 81.

With respect to present claims 15 and 74, Since Gonsalves's polymer contains SiO moieties, it is the Examiner's position that the prior art teaches present oxide of silicon of claim 15 and present oxide of claim 74. Thus, prior art teaches present inventions of claims 15 and 74.

With respect to present claims 20 and 35, Gonsalves states that his resist system is also promising system for e-beam nanolithography. Therefore, one of ordinary skill in the art would immediately envisage using Gonsalves's resist in e-beam nanolithography. Therefore, the prior art teaches present inventions of claims 20 and 35.

With respect to present claims 26 and 82, since Gonsalves teaches present polymeric resist of claim 22 and 14, it is the Examiner's position that Gonsalves's resist would inherently have the present glass transition temperature range of claims 26 and 82. Therefore, the prior art teaches present inventions of claims 26 and 82.

With respect to present claim 75, since Gonsalves's terpolymer contains t-butyl group (which is an acid-labile group which decomposes upon exposure), the prior art teaches present invention of claim 75.

24. Claims 6, 7, 14, 15, 17, 19-21, 74-78, and 80-82 are rejected under 35 U.S.C. 102(a) as being anticipated by Hu et al ("Nanocomposite Resists for Electron Beam Nanolithography", Microelectronic Engineering, 56 (2001), pg.289-294).

Hu teaches (see pg.289-291) a nanocomposite resist (useful for producing integrated circuits) containing silica nanoparticle (having diameters in the 1-2 nm range) modified ZEP520 (poly(α -chloroacrylate-co- α -methyl styrene which is a chain-scission type resin) according to present specification), and Hu performs e-beam lithography using the resist. Therefore, Hu teaches present inventions of claims 6, 7, 14, 15, 17, 19, 20, 74-78, 80, and 81.

With respect to present claim 21, Hu states that extreme UV, X-ray, e-beam and ion-beam lithographies have become more promising candidates for next generation nanofabrication. Therefore, one of ordinary skill in the art would immediately envisage performing ion-beam lithography in Hu's invention. Therefore, the prior art teaches present invention of claim 21.

Since Hu teaches present nanocomposite resist of claim 14, it is the Examiner's position that Hu's resist would inherently have the present range of glass transition temperature. Therefore, the prior art teaches present invention of claim 82.

25. Claims 22-27, 30-32, 35, and 37 are rejected under 35 U.S.C. 102(b) as being anticipated by Wu et al (Chemical Abstract for "Polymer-Inorganic High Contrast and

High Sensitivity Resists for Nanolithography", Materials Research Society Symposium Proceedings, 584 (Materials Issues and Modeling for Device Nanofabrication). Pg.121-128, 2000).

Wu et al teaches (see Chemical Abstract) an x-ray resist copolymer containing methyl methacrylate repeat unit and present 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate repeat unit in the mass ratio of 85.8/14.2. Therefore, the prior art teaches present inventions of claims 22-25. Also, since Wu teaches present polymeric resist of claim 22, it is the Examiner's position that Wu's polymeric resist would inherently have a glass transition temperature greater than about 165°C as presently recited in claim 26. Thus, Wu teaches present invention of claim 26.

With respect to present claim 27, although the abstract does not disclose the molecular weight for Wu's copolymer, the copolymer would inherently have a certain weight average MW, and it is the Examiner's position that the MW value for Wu's copolymer would fall within the broadly claimed present range of 100,000 or more. Thus, it is the Examiner's position that Wu teaches present invention of claim 27.

With respect to present claim 30, since Wu's copolymeric resist is a high sensitivity resist for *nanolithography*, it is the Examiner's position that the prior art impliedly teaches the present lithographic process of claim 30. Therefore, it is the Examiner's position that Wu teaches present inventions of claims 30-32 and 37.

With respect to present claim 35, Wu also teaches that by carefully manipulating components and composition, his copolymer could potentially be used as a DUV or e-

beam resist as well. Therefore, one of ordinary skill in the art would immediately envisage using e-beam for Wu's nanolithography process. Thus, the prior art teaches present invention of claim 35.

26. Claims 22-24, 26, and 27 are rejected under 35 U.S.C. 102(b) as being anticipated by Pyun et al (Chemical Abstract for "Synthesis of Organic/Inorganic Hybrid Materials from Polysiloxane Precursors Using Atom Transfer Radical Polymerization", *Polymer Preprints*, 40(2), pg.454-455, 1999).

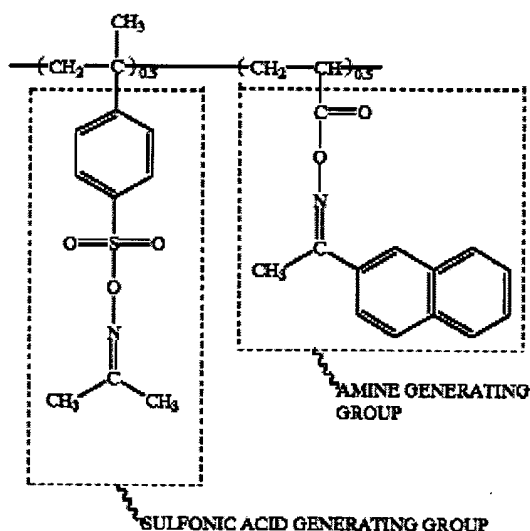
Pyun teaches (see the Abstract) a copolymer containing present present 3-(3,5,7,9,11,13,15-heptacyclopentylpentacyclo-[9.5.1.1^{3,9}.1^{5,15}.1^{7,13}]octasiloxane-1-yl)propyl methacrylate repeat unit and present methyl methacrylate repeat unit. Thus, the prior art teaches present inventions of claims 22-24.

Since Pyun teaches present polymeric resist of claim 22, it is the Examiner's position that the prior art's copolymer would inherently have a glass transition temperature greater than about 165°C as presently recited in claim 26. Therefore, Pyun teaches present invention of claim 26.

With respect to present claim 27, although the abstract does not disclose the molecular weight for Pyun's copolymer, the copolymer would inherently have a certain weight average MW, and it is the Examiner's position that the MW value for Pyun's copolymer would fall within the broadly claimed present range of 100,000 or more. Thus, it is the Examiner's position that Pyun teaches present invention of claim 27.

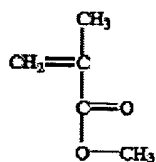
27. Claims 38, 39, 47, 51, 52, 57, and 59 are rejected under 35 U.S.C. 102(b) as being anticipated by Matsuo et al (5,965,325).

In Embodiment 3 (see col.18, and col.1, lines 5-9), Matsuo teaches following resist material (which is used in a fine-line pattern forming method to manufacture a semiconductor *integrated circuit device* and the like):

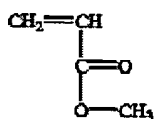


Matsuo teaches (col.18, lines 15-20) that the first repeat unit of the copolymer generates sulfonic acid through irradiation with ArF excimer laser. Matsuo also teaches (col.26, lines 12-35) that in the third embodiment, the copolymer as shown above can be further polymerized with one of the following monomers;

Chemical Formula 28:



Chemical Formula 29:



Based on this teaching, one of ordinary skill in the art would immediately envisage a tertiary polymer that contains those two repeat units shown in Embodiment 3 and another repeat unit formed from the methyl methacrylate monomer (chemical formula 28). Therefore, the prior art teaches present inventions of claim 38.

With respect to present claim 47, Matuso's tertiary polymer would inherently possess a certain weight-average MW value, and it is the Examiner's position that the MW value would fall within the broad range of 20,000 to 100,000 as presently claimed. Thus, it is the Examiner's position that the prior art teaches present invention of claim 47.

In Embodiment 3 (see col.18, lines 13-67, col.19-20, col.21, lines 1-24), Matuso *imagewise* exposes his coated resist film to ArF excimer laser (first energy beam) thereby transferring a pattern of the mask onto the resist film. On the imagewise exposed area, sulfonic acid is generated. Next, the entire surface of the resist film is irradiated with a second energy beam to generate amine on the entire surface of the resist film. In the area which is imagewise-exposed earlier (where the sulfonic acid is generated), the sulfonic acid is neutralized with the amine. On the other hand, in the area which was not imagewise-exposed earlier (where no sulfonic acid is generated), amine is generated. After that, metal alkoxide is sprayed on the surface of the resist film thereby selectively forming an oxide film on the area which was not imagewise-exposed earlier (the oxide film cannot be formed in the area which was imagewise-exposed earlier). Then by using the oxide film as a mask, etching is performed to

remove the area which was imagewise-exposed earlier. Therefore, Matsuo teaches present inventions of claims 51, 52, and 57.

With respect to present claim 59, Matsuo teaches (col.26, lines 1-4) that the ArF excimer laser which is used as a light source for the pattern exposure (the first energy beam) can be replaced with an i-line, KrF excimer laser, EB, X-rays or the like. Since there are only a few choices, one of ordinary skill in the art would immediately envisage using X-rays for the imagewise exposure step. Therefore, the prior art teaches present invention of claim 59.

28. Claims 38, 42, 43, 47, 48, 51, 55, and 62 are rejected under 35 U.S.C. 102(a) as being anticipated by Wu et al ("A novel Single-Component Negative Resist for DUV and Electron Beam Lithography", *Advanced Materials*, 2001, 13(3), pg.195-197) (with Rizzardo et al (6,512,081 B1), which is cited here to support the Examiner's assertion that living polymerization produces polymers having low polydispersity index).

Wu teaches a chemically amplified resist containing a sulfonium group-containing polymer (see pg.195, right-hand column). Wu's polymer is formed from a sulfonium group-containing monomer by living radical polymerization using AIBN, and the polymer structure shown in his Fig.1 includes the present photoacid generating component of $[p\text{-CH}_2=\text{C}(\text{CH}_3)\text{C}(\text{O})\text{-OC}_6\text{H}_4\text{SMe}_2]\text{OSO}_2\text{CF}_3$, which also includes a methacrylate moiety ($p\text{-CH}_2=\text{C}(\text{CH}_3)\text{C}(\text{O})\text{-O-}$). Therefore, the prior art's resist teaches present inventions of claims 38, 42, 43, and 62 (*present claim language does not require that the methacrylate component and the photoacid generating component have to come from the two different repeat units of a polymer*).

With respect to present claim 47, although Wu does not explicitly disclose the average MW for his polymer, the polymer would inherently have a certain value for the average MW, and it is the Examiner's position that the MW would fall into the broadly claimed range of 20,000 to 100,000 g/mol. Thus, it is the Examiner's position that the prior art teaches present invention of claim 47.

With respect to present claim 48, since Wu's polymer is formed by living polymerization, it is the Examiner's position that Wu's polymer would inherently have a polydispersity index value that falls within the present range of 1-2 since living polymerization produces polymers with narrow molecular weight distribution or low polydispersity index, as evidenced by Rizzardo, col.1, lines 22-53. Therefore, the prior art teaches present invention of claim 48.

Wu states (pg.195) that the major requirement for polymer materials to be used for microlithography is that upon exposure to irradiation they undergo structural change to provide *solubility differentiation between the exposed and unexposed regions*. Wu furthermore states (pg.195, right-hand column) that upon *exposure* to 254 nm DUV irradiation, his polymer underwent a polarity change. Wu states (pg.196) that the unexposed polymer was polar due to its ionic character and *soluble in polar solvents* such as water. In the irradiated portion, the polymer becomes less polar by losing its ionic character and was thus found to be *insoluble in polar solvents*. Therefore, Wu teaches present exposing step and developing step of claim 51. Thus, the prior art teaches present invention of claims 51 and 55.

Claim Rejections - 35 USC § 103

29. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

30. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over by Wu et al (Chemical Abstract for "Polymer-Inorganic High Contrast and High Sensitivity Resists for Nanolithography", *Materials Research Society Symposium Proceedings*, 584 (Materials Issues and Modeling for Device Nanofabrication). Pg.121-128, 2000) in view of Moran et al (4,225,664).

Wu is discussed above in Paragraph 25. Although Wu does not explicitly state that his X-ray resist is used in manufacturing an integrated circuit device, it is widely known in the art to use such X-ray resist in making semiconductor device such as integrated circuits, as evidenced by Moran, col.1, lines 12-58. Therefore, it would have been obvious to one of ordinary skill in the art to use Wu's X-ray resist material to make an integrated circuit device because it is widely known practice to do so as evidenced by Moran. Therefore, Wu in view of Moran would render obvious present invention of claim 34.

31. Claims 30-32, 35, and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pyun et al (Chemical Abstract for "Synthesis of Organic/Inorganic Hybrid Materials from Polysiloxane Precursors Using Atom Transfer Radical Polymerization", *Polymer Preprints*, 40(2), pg.454-455, 1999) in view of Wu et al

(Chemical Abstract for "Polymer-Inorganic High Contrast and High Sensitivity Resists for Nanolithography", Materials Research Society Symposium Proceedings, 584 (Materials Issues and Modeling for Device Nanofabrication). Pg.121-128, 2000).

Pyun is discussed in Paragraph 26. Pyun does not state that his copolymer is used in a lithography process. Wu teaches (see the Abstract) the same copolymer as that of Pyun, and Wu teaches the use of his copolymer in an X-ray or e-beam nanolithography process. Therefore, it would have been obvious to one of ordinary skill in the art to use Pyun's copolymer in an X-ray or e-beam nanolithography process as taught by Wu since Wu teaches the same copolymer as that of Pyun. Therefore, Pyun in view of Wu would render obvious present inventions of claims 30-32, 35, and 37.

32. Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pyun et al (Chemical Abstract for "Synthesis of Organic/Inorganic Hybrid Materials from Polysiloxane Precursors Using Atom Transfer Radical Polymerization", *Polymer Preprints*, 40(2), pg.454-455, 1999) in view of Wu et al (Chemical Abstract for "Polymer-Inorganic High Contrast and High Sensitivity Resists for Nanolithography", Materials Research Society Symposium Proceedings, 584 (Materials Issues and Modeling for Device Nanofabrication). Pg.121-128, 2000) as applied to claim 30 above, and further in view of Moran et al (4,225,664).

Pyun in view of Wu is discussed above in Paragraph 31. Although Wu does not explicitly state that his X-ray resist is used in manufacturing an integrated circuit device, it is widely known in the art to use such X-ray resist in making semiconductor device such as integrated circuits, as evidenced by Moran, col.1, lines 12-58. Therefore, it

would have been obvious to one of ordinary skill in the art to use Pyun's copolymer in X-ray nanolithography process (as taught by Wu) in order to make an integrated circuit device because it is widely known practice to do so as evidenced by Moran. Therefore, Pyun in view of Wu and further in view of Moran would render obvious present invention of claim 34.

33. Claim 57 is rejected under 35 U.S.C. 103(a) as being unpatentable over by Wu et al ("A novel Single-Component Negative Resist for DUV and Electron Beam Lithography", *Advanced Materials*, 2001, 13(3), pg.195-197) in view of Kinoshita et al (6,479,210 B2).

Wu is discussed above in Paragraph 28. Although Wu does not explicitly state that his chemically-amplified resist is used in manufacturing an integrated circuit, it is widely known in the art that chemically amplified resist composition is used in manufacturing integrated circuit elements or the like as evidenced by Kinoshita et al, col.1, lines 5-13. It would have been obvious to one of ordinary skill in the art to use Wu's CA resist in microlithography to manufacture an integrated circuit because it is widely accepted practice to do so in the art. Therefore, Wu in view of Kinoshita would render obvious present invention of claim 57.

34. Claims 6, 7, 14-17, 19, 20, 74-79, 81, and 82 are rejected under 35 U.S.C. 103(a) as obvious over Angelopoulos et al (6,420,084 B1) in view of Haddad et al ("Hybrid Organic-Inorganic Thermoplastics: Styryl-Based Polyhedral Oligomeric Silsesquioxane Polymers", *Macromolecules*, 1996, vol. 29, pg.7302-7304) (with Lichtenhan et al (6,716,919 B2), which is cited here to support the Examiner's assertion

that octacyclohexyl polyhedral oligomeric silsesquioxane (octacyclohexyl POSS) is known to have the particle diameter size of about 1.5 nm).

Angelopoulos teaches (col.1, lines 5-11, col.2, lines 61-67, col.3, lines 1-3) a resist composition, useful for obtaining patterned structures of various materials such as semiconductors, containing a polymeric component where: (i) at least a portion of the polymeric component contains SiO moieties, (ii) at least a portion of the polymeric component contains pendant acid labile moieties which inhibit solubility of the resist in aqueous alkaline solutions, and (iii) at least a portion of the polymeric component containing pendant polar moieties. Angelopoulos also teaches (col.5, lines 36-67, col.6, lines 1-10) that some or all-of the SiO-containing polymer of the polymeric component may have SiO moieties present in pendant groups from the polymer backbone. For example, Angelopoulos states, polyhedral oligomeric silsesquioxane (POSS) can be grafted onto backbone polymers such as polystyrene or more preferably polyhydroxystyrene. Angelopoulos furthermore states that examples of such oligomers are described in an article title "Hybrid Organic-Inorganic Thermoplastics: Styryl-Based Polyhedral Oligomeric Silsesquioxane Polymers" by Haddad et al. published in *Macromolecules*, vol.29, p.7302-7304 (1996), the disclosure of which he incorporates by reference.

Based on this teaching, it would have been obvious to one of ordinary skill in the art to use the styryl based polyhedral oligomeric silsesquioxane polymers which are disclosed in Figure 2 of Haddad et al (the POSS disclosed in Haddad has the formula of $\text{Si}_8\text{O}_{12}\text{R}_8$ where seven of those R groups represent cyclohexyl groups and one of the

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remaining R group represents an ethyl group) as the portion of Angelopoulos's polymeric component containing SiO moieties because Angelopoulos is pointing to Haddad et al for the examples of the SiO-containing polymer having SiO moieties in pendant groups. The octacyclohexyl POSS is known to have the particle diameter size of about 1.5 nm as evidenced by Lichtenhan et al (see col.5, Table 1). Since the POSS disclosed in Haddad has seven cyclohexyl groups and an ethyl group as the R groups, it is the Examiner's position that the POSS of Haddad would have the similar value (i.e., about 1.5 nm) for the particle diameter size to that of the octacyclohexyl POSS. Angelopoulos furthermore teaches (col.7, lines 45-67, col.8, lines 1-3) a method of creating a patterned material structure on a substrate, the method comprising;

- (a) providing a substrate having material layer thereon to be patterned,
- (b) providing a layer of positive resist over the material layer, the radiation-sensitive resist comprising a polymeric component, at least a portion of the polymeric component containing SiO moieties, at least a portion of the polymeric component containing pendant acid labile moieties which inhibit solubility of the resist in aqueous alkaline solutions, and at least a portion of the polymeric component containing pendant polar moieties which promote alkaline solubility of the resist in aqueous alkaline solutions,
- (c) pattern wise exposing portions of the resist to imaging radiation,
- (d) removing the exposed portions of the resist to form spaces defined by remaining unexposed portions of the resist layer,
- (e) removing portions of the material layer at the spaces by contacting the material layer with an etchant compound comprising a halogen atom selected from the group consisting of Cl, Br, and I, and
- (f) removing any remaining portions of the resist layer.

Therefore, Angelopoulos in view of Haddad et al would render obvious present invention of claims 6, 7, 14, 16, 19, 76-79, and 82 (it is the Examiner's position that since Angelopoulos teaches present nanocomposite resist of claim 14, the prior art's

resist would inherently have the present glass transition temperature range of 160°C or more).

With respect to present claim 17, as discussed above, at least a portion of Angelopoulos's polymeric component contains pendant acid labile moieties which inhibit solubility of the resist in aqueous alkaline solutions. Angelopoulos teaches (col.5, lines 5-6) *acetal group* as one of the examples for the acid labile moiety. It would have been obvious to one of ordinary skill in the art to have at least a portion of Angelopoulos's polymeric component to contain acetal group, which inhibit solubility of his resist in aqueous alkaline solutions, with a reasonable expectation of obtaining improved resist composition. Therefore, Angelopoulos in view of Haddad would render obvious present invention (polyacetals) of claim 17.

Since Angelopoulos's polymer contains SiO moieties, it is the Examiner's position that the prior art teaches present oxide of silicon of claim 15 and present oxide of claim 74. Thus, Angelopoulos in view of Haddad et al would render obvious present invention of claim 74.

Angelopoulos teaches (col.8, lines 34-36) that his resist layer is patternwise exposed to electron beam or deep UV radiation. Thus, Angelopoulos in view of Haddad et al would render obvious present invention of claim 20. Also, Angelopoulos's resist composition contains the polymeric component (as describe above), which contains an acid-labile moiety, which is insoluble in aqueous alkaline solution initially, but upon exposure becomes soluble in the same solution due to the acid-catalyzed

decomposition of the acid-labile moiety). Therefore, Angelopoulos in view of Haddad et al would also render obvious present invention of claim 75.

With respect to present claim 81, Angelopoulos teaches (col.6, lines 37-46) that the overall polymeric component should preferably contain about 9-22 wt% of the SiO moiety. One of ordinary skill in the art would immediately envisage having 9 wt.% of the SiO moiety in Angelopoulos's polymeric component since 9 wt.% is clearly disclosed as the lower end of the taught range. Therefore, Angelopoulos in view of Haddad et al would render obvious present invention of claim 81.

Allowable Subject Matter

35. Claims 18, 33, 36, 40, 41, 44-46, 53, 54, and 58 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Angelopoulos'084 in view of Haddad (Macromolecules article) do not teach or suggest present poly(α -chloroacrylate-co- α -methyl styrene) of claims 18.

The Chemical Abstracts for Wu et al (Materials Research Society Symposium Proceedings) and Pyun et al (Polymer Preprints) do not teach or suggest present polymeric resist of claim 33. Neither of Wu and Pyun teaches or suggests present ion-beam radiation process of claim 36.

Neither of Matsuo et al'325 and Wu et al (Advanced Materials) teaches or suggests present polymeric resist of claim 40 containing a dissolution-promoting moiety. Also, neither of those references teaches or suggests present polymeric resist of claim

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44 containing a polyhedral oligosilsesquioxane component. Neither of those references teaches or suggests present polymeric resist of claim 53 containing the dissolution-promoting moiety. Neither of those references teaches nor suggests present extreme UV radiation process of claim 58.

36. Claims 11, 29, 49, 50, and 65-71 are allowed. None of the cited prior arts teaches or suggests present combination of polyhedral oligosilsesquioxane and poly(α -chloroacrylate-co- α -methyl styrene) of claim 11. None of the cited prior arts teaches or suggests present polymeric resist of claim 29 which contains all of those four repeat units. None of the cited prior arts teaches or suggests present polymeric resist of claim 49 which contains all of those five repeat units. None of the cited prior arts teaches or suggests present polyacetal polymer of claim 65 into which a polyhedral oligosilsesquioxane disilanol component is incorporated.

37. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sin J. Lee whose telephone number is 571-272-1333. The examiner can normally be reached on Monday-Friday from 9:00 am EST to 5:30 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly, can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Business Center (EBC) at 866-217-9197 (toll-free).

S. J. Lee

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October 28, 2004

Sin J. Lee

Sin J. Lee

Patent Examiner

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